Regional Science and Urban Economics 57 (2016) 38–45

Contents lists available at ScienceDirect

Regional Science and Urban Economics

journal homepage: www.elsevier.com/locate/regec

Did the Computer Revolution shift the fortunes of U.S. cities? Technology shocks and the geography of new jobs☆

Thor Berger [a], Carl Benedikt Frey [b]

[a] Department of Economic History, School of Economics and Management, Lund University, Sweden
[b] Oxford Martin School, University of Oxford, United Kingdom

ARTICLE INFO

Article history:
Received 15 January 2015
Received in revised form 12 November 2015
Accepted 18 November 2015
Available online 9 December 2015

JEL classification:
R11
O31
O33

Keywords:
New jobs
Technological change
Urban development

ABSTRACT

This paper shows how the Computer Revolution of the 1980s shifted the economic trajectories of U.S. cities. Examining the emergence of new occupational titles in official census classifications, we document a sharp reversal in the skill content of new jobs. While technological change was biased towards routine skills throughout the 1970s, new job titles mainly appeared in occupations and industries that required abstract skills after 1980. This reversal is also reflected in the geography of new jobs. Following the Computer Revolution, the creation of new jobs shifted towards cities with endowments of analytical and interactive skills. Our results suggest that the recent divergence of U.S. cities can in part be explained by the complementarities between new technologies and skill endowments.

1. Introduction

Why is prosperity so unevenly distributed across the United States? In *The New Geography of Jobs*, Moretti (2012) argues that America's "Great Divergence" has its origins in the 1980s, when the abundance of skills started to dictate the fortunes of U.S. cities. Over recent decades, initially skilled areas have attracted even more skilled workers, explaining in part why income convergence in the United States has come to halt (Barro et al., 1991; Berry and Glaeser, 2005; Ganong and Shoag, 2012). While there is an ongoing debate about the driving forces behind this phenomenon, one explanation points towards a tendency of skilled cities to adopt technology in ways that create new jobs for more skilled workers (Beaudry et al., 2010; Lin, 2011).

In this paper, we show how a previously undocumented shift in the skill content of new jobs, following the Computer Revolution of the 1980s, has altered patterns of new job creation across U.S. cities.[1] Our analysis builds on the intuition of Jacobs (1969), suggesting that the economic trajectories of cities are shaped by their deployment of skills to create new jobs as old ones are made redundant by the arrival of new technologies. For example, during the early part of the 20th century, factory mechanization increased the demand for machine operatives performing routine tasks (Goldin and Katz, 1998). In contrast, over recent decades, computer-controlled equipment has substituted for a wide range of routine work—including the jobs of machine operatives, bookkeepers and telephone operators—while creating new jobs that require abstract skills, such as computer programming and software engineering (Autor et al., 2003).

To identify the appearance of new jobs, we exploit the inadvertent paper trail left by new technologies in new occupational titles from Lin (2011). Paired with data on job task descriptions from the 1977 Fourth Edition of the Dictionary of Occupational Titles (DOT), allowing us to infer on-the-job skill requirements, we show that new jobs mainly appeared in occupations and industries that required routine skills prior to the 1980s. Nevertheless, over the course of the 1980s, new jobs became more abstract in nature—that is, they gradually required more analytical and interactive skills. Using data from the Current Population Survey (CPS) supplements, we show that this shift is intimately associated with the Computer Revolution: after 1980, new jobs mainly appeared in occupations and industries that extensively adopted computers.

Fig. 1 documents the impact of the changing skill content of new jobs on cities, showing a sharp reversal in the relationship between abstract skill endowments and new job creation across locations.

☆ We are grateful to Giovanni Peri (the editor), two anonymous referees, David Autor, David Dorn, Kerstin Enflo, Martin Henning, Jeffrey Lin, Frank Neffke, Robert Valletta, and seminar participants for their helpful advice, comments, and suggestions that substantially improved the paper. Berger gratefully acknowledges funding from the Swedish Research Council (#2008–2023) and the Crafoord Foundation (#20130812). The usual disclaimer applies.

E-mail addresses: thor.berger@ekh.lu.se (T. Berger), carl.frey@oxfordmartin.ox.ac.uk (C.B. Frey).

[1] Throughout the paper, we refer to the period commencing with the arrival of the personal computer (PC) in the 1980s and continuing with the development of the World Wide Web in the 1990s as the "Computer Revolution".

http://dx.doi.org/10.1016/j.regsciurbeco.2015.11.003
0166-0462/

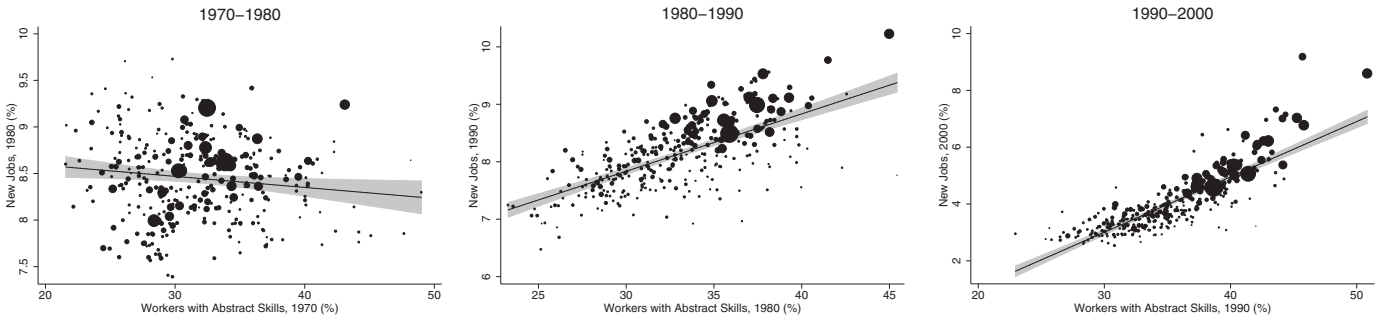

Fig. 1. Abstract skills and new job creation in U.S. cities, 1970–2000.

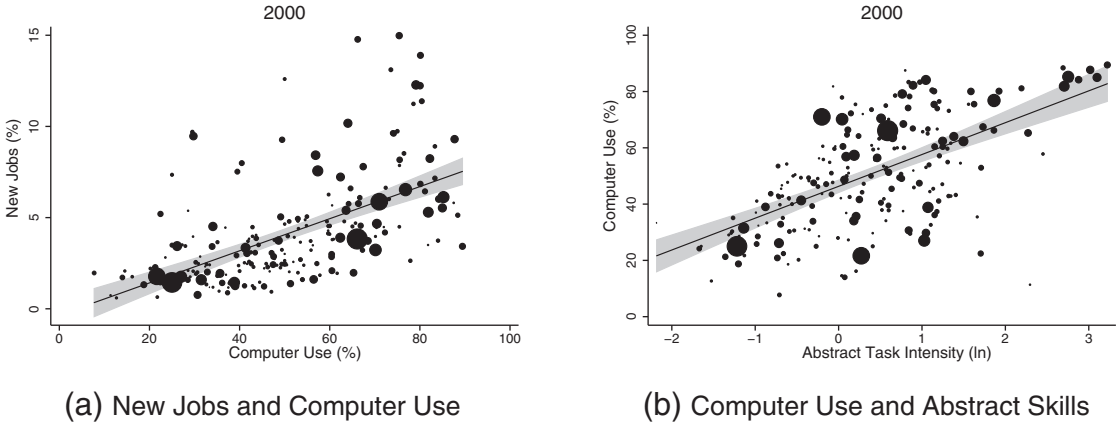

Fig. 2. Abstract skills, computer use, and new jobs, 2000.

Throughout the 1970s, abstract cities experienced slightly slower new job creation. Following the diffusion of the PC in the 1980s and 1990s, however, the very same cities adapted faster by creating new jobs. While this pattern resonates with an aggregate shift in the U.S. labor market towards jobs that demand abstract skills, it also reveals substantial variation in rates of adaption to the Computer Revolution across U.S. cities. (See Fig. 2.)

In our main empirical analysis, we begin by showing that differences in computer adoption can account for much of the variation in new job creation across cities and that computers were more extensively adopted in cities with an abundance of abstract skills. We next examine the relationship between abstract skills and new job creation across U.S. cities before and after the Computer Revolution. Doing so, we show that while there is virtually no relationship between abstract skills and new job creation prior to the Computer Revolution, there is a strikingly strong relationship from the 1980s onwards. This relationship is robust to alternative explanations, emphasizing the role of differences in city size, the relative supply of college-educated workers, and cities' reliance on manufacturing. (See Table 6.)

Our paper relates to several literatures. First, our paper is most closely related to Beaudry et al. (2010), documenting that cities with an abundance of college-educated workers experienced more rapid computer adoption, and Lin (2011), finding that cities where college-educated workers are plentiful have created more new jobs since the 1980s. Nevertheless, evidence suggests that workers' skills are intrinsically related to the type of tasks they perform (e.g., Murnane et al. (1995); Ingram and Neumann (2006); Poletaev and Robinson (2008); and Gathmann and Schönberg (2010). Following Bacolod et al. (2009), arguing that if workers are assigned to jobs in a hedonic market clearing process, worker's skills can be inferred from the tasks they perform on their jobs, we therefore make use of the 1977 DOT to examine the complementarities between a wider range of skills and the arrival of new technologies.[2] Thus, in contrast to Beaudry et al. (2010) and Lin (2011) that equate workers' skills with their educational attainment, we differentiate between different skills based on detailed descriptions of the actual tasks performed by workers, allowing us to (i) reveal a previously undocumented shift in the skill content of new jobs, and (ii) document a direct link between the Computer Revolution of the 1980s and the changing geography of new jobs across U.S. cities.[3]

Our findings also contribute to a growing literature that examines the polarization of labor markets over recent decades, resulting from changes in the task composition of occupations and the reallocation of workers away from routine task-intensive jobs (Goos and Manning, 2007; Goos et al., 2009; Frey and Osborne, 2013; Michaels et al., 2013; Goos et al., 2014).[4] In tandem with computers substituting for labor in routine tasks, this literature documents an increased labor input of abstract tasks, which computers complement (Autor et al., 2003). We add to this literature by showing that the changing skill content of new jobs constitutes a potentially important margin of task change, that can partly account for the increased labor input of abstract tasks within occupations (e.g., Spitz-Oener (2006).

[2] See Autor et al. (2003); Ingram and Neumann (2006); Bacolod et al. (2009); Autor and Dorn (2013) and Michaels et al. (2013) for other examples of use of the DOTs.

[3] Furthermore, an important limitation with single technology measurements, such as the PC adoption measure employed by Beaudry et al. (2010), is that they do not capture the relative impact of different technologies on labor markets. New jobs, on the other hand, allow us to examine the relationship between new means of production both before and after the Computer Revolution.

[4] In particular, Autor and Dorn (2013) show that, across U.S. local labor markets, investments in computer equipment led to the displacement of workers performing routine tasks, leading to a "hollowing out" of employment. By contrast, we find that in cities with endowments of abstract skills, computer technologies are implemented in new jobs.